Exploring the Needs of Preschool-aged Children, Parents, and Grandparents for Communicating Over Distance

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Figure 1. Three prototypes presented to preschool-aged children and parents through videos.

The relationship between children and extended family members (such as grandparents) is extremely important, providing meaning, knowledge, and enjoyment. However, the distributed nature of our modern society has made it difficult for young children to remain connected with extended family. We conducted a study with young children and their parents, as well as grandparents of young children, to explore their needs and preferences when communicating remotely. Through the use of video prototypes, we found a number of themes related to the types of interactions that devices should afford for young children and grandparents. These include tensions between children's independence and parental control, the need for child-led bursts of interaction, and considerations on device lifetime and the link to remote family members. In this paper, we detail our methodology and findings to arrive at design values for this particular user group.

CCS CONCEPTS • **Human-centered computing** • **Human computer interaction (HCI)** • **Empirical studies in HCI**

Additional Keywords and Phrases: Young child communication, preschool-aged children, grandchild-grandparent communication

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1 INTRODUCTION

Individuals often have a strong desire to maintain awareness of other family members [27, 35] and frequent and meaningful communication between family members is essential to maintain close relationships [42]. The continued increase of geographically distributed families, in addition to the onset and aftermath of the COVID-19 pandemic, have made it increasingly difficult for families to stay connected and spend time co-located. For example, it is not only difficult for grandchildren to maintain close relationships with their grandparents due to geographical distance [41], but asymmetries in their routines [38] and the need for parental scaffolding to assist communication [7, 26] also add to the problem. For this reason, researchers have investigated various ways in which technology can help.

In our work, we focus on how young children can connect with remote grandparents over distance. We define young children as pre-school children between the ages of 3 and 5. Young children present specific challenges when it comes to connecting with remote family members and using communication technologies. Children's lack of sophisticated verbal skills [10], reading skills, their limited attention span [17, 43], and an inability to understand the importance of the connection or the steps needed to make it successful [3] make it more difficult to engage them in remote communication with family members. While research from other fields, such as Developmental Psychology, can help to provide insight into child-specific aspects related to interaction with others, our research in human-computer interaction contributes to this area to help fill a gap in the design of technology for this particular user group.

There are notable examples of research that looks at building systems to make it possible for young children to share media of artifacts with remote family such as grandparents. Collage enables this by allowing sharing of photos and text messages [40], and StoryBox combines both, providing an interactive surface and the ability to easily send photos along with handwritten messages [43]. Other research has focused on the types of activities that children can do with their grandparents remotely such as adventure games [25], reading [31, 32], and sharing music [39], or on bringing awareness of the other's daily life [19, 20]. However, the focus is often on elementary school age children (i.e., 6+ years old) and tends to leave out the experiences and needs of preschool-aged children. Notable exceptions include work on Family Story Play [31] and StoryVisit [32] where studies included some preschool-aged children.

In our research, we investigated how distributed young children and grandparents in North America would like to keep in touch through the use of technology. We used grandparents as an example of family members that young children may want to connect with due to the importance of this relationship [23]. In addition, we explored parents' perceptions of such types of technologies for their children. First, we created three video prototypes of potential technologies that could connect young children with their grandparents over distance:

1. **TeddyGran** — a teddy bear with embedded tablet that supported synchronous video calls with remote grandparents;
2. **OurStory** — two interconnected touch screens that allowed young children to illustrate stories told by grandparents over distance; and,
3. **GranPortal** — an ambient video portal dedicated to sharing video solely between a young child and grandparents in a one-to-one connection modality.

Our video prototypes were created after reviewing prior research and completing multiple rounds of iterative brainstorming and storyboarding. All prototypes focused heavily on the use of video calling or recording, given the success of this type of technology across the literature (e.g., [19, 20, 31, 32]) as well as a reduction in the need for parent scaffolding. In contrast to prior work, we wanted to explore the idea of children interacting more independently with their grandparents, freeing some of the burden placed on parents [31, 32]. We used video prototypes as opposed to real technologies such that we could create scenarios around the usage of the prototype ideas to solicit reactions from

children and their parents, as well as grandparents. Next, we conducted a two-phased study. In the first phase, our participants were young children and their parents. In the second stage, participants were grandparents of children in the same age range. In both phases, we obtained their feedback on the ideas presented in the three video prototypes, highlighting possible design directions for this particular demographic. Our study focused on answering three main research questions:

- **RQ1:** what are young children's perceptions (and therefore design preferences) of the prototypes to communicate with their grandparents?
- **RQ2:** what are parents' preferences and concerns for devices, such as our prototypes, that enable their young children to communicate with their grandparents?
- RQ3: what are grandparents' preferences and concerns for devices, such as our prototypes, that enable their young grandchildren to communicate with them?

Overall, the goal of the study was to provide insight into how young children view their interactions with their grandparents, and how children, parents, and grandparents believe different design approaches for grandchild-grandparent communication might fit into their lives. Our research stands out from existing literature by focusing on young children and their parents, two user groups that are often understudied in grandchild communication studies, in addition to including grandparents. Our findings suggest that communication systems for young children and grandparents should support new forms of interaction not present in existing forms of communication technologies as well as semi-independent use (to name a few). The contributions of this research are as follows:

a) Findings and a discussion on the types of solutions that might allow young children to communicate with remote grandparents, filling gaps of existing systems, and
b) Design values to aid the communication between distributed preschool-aged children and remote grandparents, based on children's, parents', and grandparents' feedback.

In the following sections, we detail previous research that is relevant to our work, as well as our study design and findings. We end by providing design values as well as potential technological solutions for young children.

2 RELATED WORK

Preschool-aged children tend to have difficulties considering others' points of view, as this requires the presence of theory of mind (the ability to attribute mental states to themselves and others [30]) and the ability to take others' perspectives [3, 44]. This leads to challenges when communicating with others over non-visual methods (e.g., talking on the phone), causing young children to be unmotivated to speak on the phone with grandparents. Video calls therefore tend to be the preferred method, as young children are more likely to participate in them for longer periods of time than phone calls [3]. Video calls also enable children to express their knowledge more easily through action instead of words [3]. By 5 years of age, children can partake in in-person conversations but require assistance with remote ones [3]. Differences in communication abilities of preschool-aged children can also be due to their developing understanding of false belief, as children who perform well in false belief tasks tend to provide more useful information to their communication companions [34]; this can affect the way they communicate with others during phone or video calls.

The relationship between young children and their grandparents is an especially important family connection as they play important social roles in each other's lives [26, 41]. Grandparents often attempt to impart values or morality through joint activities with their grandchildren [14] – such as taking care of the grandchildren, explaining things, and viewing TV or videos together [41] – and they sometimes put much work into communicating with their grandchildren, by learning their interests to guide conversation with them [13]. In turn, children prefer grandparents that they have daily

contact with [41]. When it comes to preferences for communicating with extended family, such as grandparents, young children typically share recent mundane events [15], lacking the theory of mind to understand what others might be interested in. However, older children are interested in learning more detailed information about their grandparent's lives, especially unexpected information [15]. Children also prefer scheduled communication, as opposed to impromptu exchanges [13], likely due to their lack of control when they are not given the option of when to schedule interaction. When they do take part in online activities with grandparents, children prefer activities that are short, simple, easy to understand, easy to learn, and easy to partake in, and benefit from repeated interaction design [15].

Video calls between young children and extended family (such as grandparents) tend to start with the child's family gathered as a group in front of the device's screen [3], and is thus a family affair. For grandchildren and grandparents, for example, social interaction is rooted in the exchange of knowledge [37]; During video calls, young grandchildren like to show-and-tell to their grandparents and perform for them [3], to show off what they have learned and demonstrate any new abilities [13]. Social interaction between grandparents and grandchildren therefore tends to be grounded on the exchange of knowledge [37], including during video communication [33].

Grandparents find communicating with their grandchildren important, as it provides them with meaning and joy [23]. One source of happiness is learning about their grandchildren's achievements and remembering shared experiences, as well as knowing about their day-to-day activities [24]. When communicating with their grandchildren, grandparents find it significant to share stories and family memories to impart on their grandchildren [15]. If novel activities are to take place, grandparents like to prepare beforehand, and test online activities before using them with their grandchildren [14], due to pressure to adopt modern technologies to continue to interact with their grandchildren [37]. In general, grandparents believe it is important to watch their grandchildren grow and for their grandchildren to know them [21]. When spending time with grandchildren, grandfathers prefer partaking in activities that they also enjoy [37] and like such activities to have a set duration [15], while grandmothers have no preference between activities they or their grandchildren enjoy [37].

2.1 Technology for Family Communication

When it comes to older children (generally aged 6-11, although some case studies include younger children) and their grandparents specifically, multiple technological solutions have been proposed and tested. One category of solutions enables grandparents and grandchildren to share objects with each other through virtual means. For example, by providing a shared display through which distance-separated grandchildren and their grandparents could share virtual objects and talk [40]. StoryBox similarly allowed children and their grandparents to share artifacts that were present in the physical world and could be shared through photographs [41]. Collage also allowed grandparents and grandchildren to connect, by providing a virtual space in which to share photographs and text messages [38]. All of these systems were found to increase connectedness and bonding between grandparents and school-aged grandchildren.

Table 1. Design guidelines and requirements set forth by previous research and incorporated into our prototypes.

Guiding knowledge	Design Implication	Related Prototype	Citation
Shared activities (e.g., unstructured play) and reading books lead to better video communication	Include shared activities	TeddyGran, OurStory, GranPortal	[1, 10, 11, 43, 44]
Important to enhance communication with mementos and storytelling	Include storytelling and mementos	OurStory	[28]
Video communication enables shared context and showing of knowledge	Include video communication	TeddyGran, OurStory, GranPortal	[43]
Traditional video communication lacks the possibility to hug, touch, and kiss	Include tangible affection or proxy	TeddyGran	[14]
Might be helpful to provide physical proxies to share a sense of physicality during virtual communication	Include physical proxy	TeddyGran	[14]
Some individuals had open video call connections, without needing to talk or be on camera	Include open video connection	GranPortal	[22]
Communication devices should allow individuals to share everyday activities as they occur	Include low initiation-barrier communication	TeddyGran, GranPortal	[21]
Children engage in activities such as show-and-tell, performances, and "Skype" kisses	Include opportunity for show-and-tell, etc.	TeddyGran, GranPortal	[3]
Meaningful artifacts that remind grandparents and grandchildren of each other are essential	Include meaningful artifacts	TeddyGran, OurStory	[13]
Virtual artifacts can be turned into physical tangible mementos	Include tangible mementos	OurStory	[13]
Children enjoy their grandparents telling them stories, especially about their parents	Include storytelling	OurStory	[12]
Children like to show their abilities (e.g., artwork)	Include passive show-and-tell	GranPortal	[12]
Grandparent-grandchild conversations should be through a combination of synchronous and asynchronous technologies	Include synchronous and asynchronous interactions	TeddyGran, OurStory, GranPortal	[12]
Devices should support grandparents in telling stories to grandchildren	Include storytelling	OurStory	[12]
Seeing a loved one's handwriting leads to enhanced heightened feelings of connectedness	Include grandparents' handwriting	OurStory	[19]
Tangible reminders can require less parental scaffolding and lower barriers to communication	Include tangible objects	TeddyGran, OurStory, GranPortal	[42]

Researchers have also explored how to support distributed families' communication, including some young children (aged 2-10 years old). The FamilyWindow [20] and FamilyPortals [19] systems, for example, connected families by providing a video feed of the other's household. Families could therefore witness their relatives' daily routines and connect on a different level. The researchers found that these systems allowed families to share everyday mundane activities, leading to stronger feelings of connectedness, and that the systems themselves became the main method of communication between distributed families. Systems such as Story Places and People in Books [11] allow children to have playful interactions with long-distance family members through video, enabling fun interaction. System agnostic distributed activities have also been explored with children and grandparents, but the implementation required a dedicated space for grandparents and grandchildren [16].

Other applications have explored how reading books can connect distributed grandparents and grandchildren. Family Story Play, for example, allowed grandparents and young grandchildren to read books together remotely, with the inclusion of Elmo (from Sesame Street) to provide information and make suggestions [31]. The grandparent and grandchild both had a copy of the same physical book that they could flip through, which updated accordingly on the application. The researchers found that providing the shared activity of reading helped to ground families and keep school-aged and preschool-aged children entertained. Similarly, a longitudinal study was conducted with StoryVisit, an online system similar to Family Story Play, with findings suggesting that this category of systems appears to make video conferencing exchanges between grandparents and preschool-aged grandchildren richer in nature, including longer calls, because of the addition of an animated character, the joint reading activity, and a large reliance on parent support and scaffolding [32]. In contrast, our work explores the idea of reducing parental support and focusing on children interacting more independently with remote family members such as grandparents.

There remain many challenges when it comes to young children communicating across distance with their extended families, especially grandparents. While the research described above provides insight into grandparents' communication needs, little knowledge is available on preschool-aged children's needs nor their parents' preferences; most research that includes young children as participants does so as part of the family unit, without focusing on child-specific needs. Young children, who are still learning to communicate with others, have a hard time articulating their thoughts and feelings, as well as remaining engaged in a stationary activity [1, 3]. Co-located family members often try to engage young children in play, games, and reading [4]. However, current commercial systems typically remain unusable by young children, requiring extensive parental scaffolding and failing to keep children engaged. Our work is a step towards creating a system that young children can use independently to communicate with their remote family (as desired by parents and grandparents), to partake in activities and establish a meaningful relationship. We focus on young children's communication with grandparents, to narrow down the scope and provide specific context. We conducted a study to investigate how young children would like to keep in touch with their grandparents, and any preferences or limitations that parents and grandparents may have. We obtained children's, parents', and grandparents' feedback on three prototype ideas to explore future design directions for communication technologies for young children and grandparents. In the remaining sections, we detail our study and results, providing insight into the design of communication technologies for these specific user groups.

3 VIDEO PROTOTYPES DESIGN

We created three video prototypes (available within the supplementary materials), informed by previous literature and based on the needs of young children and grandparents, in addition to child development literature. These video prototypes were used during our virtual study to gather information on the preferences of preschool-aged children and

their parents, as well as grandparents, for communicating. We chose to use video prototypes – videos that depict a design solution and a user (representative of the target population) interacting with the system – as opposed to fully-developed and working physical prototypes, due to a lack of research with this particular age group in regard to communication technologies, with the intention of providing evidence to ground future physical prototypes and designs. Some research has used props and imaginative scenarios for similar purposes [2], but chose to ground our work in children's everyday experiences. In addition, part of this study was conducted during the COVID-19 pandemic, and video prototypes seemed more feasible for a virtual study.

To create the designs of the video prototypes, the first and last authors (both experienced in interaction design for children and families) brainstormed concepts based on the requirements gathered from existing literature (see Table 1), and then created and iterated on a number of different possible storyboards depicting usage scenarios. Figure 2 illustrates samples of some of the video prototype storyboards. As these were reviewed and modified, the designs and videos were updated as needed. The animations were created in Blender and the videos in Adobe Premiere Pro. We focused our work on coming up with multiple different designs that would vary in their features, such that study participants could compare and contrast the designs and ideas. For this reason, designs purposely varied and included synchronous vs. asynchronous interactions, talking as the main activity vs. not, and toy-like physical objects vs. not. Across all designs, the main goal was to help young children communicate with their grandparents and develop a sense of connectedness when not co-located. Given the age range of the children that we focused on (3-5 years old), our system ideas also had to involve an engaging activity, making it less likely for the children to get bored and therefore stop using the device or become disruptive with it (e.g., [1, 13]). To increase the sense of connectedness for the young children and their grandparents, we also aimed for our designs to incorporate tangible sentimentality – a concept we developed based on prior shared artifacts, storytelling practices, and tangible mementos can acquire emotional meaning over time and support family connection [13, 28, 41] – and therefore be more meaningful than merely another piece of technology. We define tangible sentimentality as the ability to physically interact with an object that has sentimental value for the user. Therefore the goal was to design systems that support the emergence of such meaningful artifacts through shared interaction. All prototype systems also included video communication, as it is easier for young children to communicate

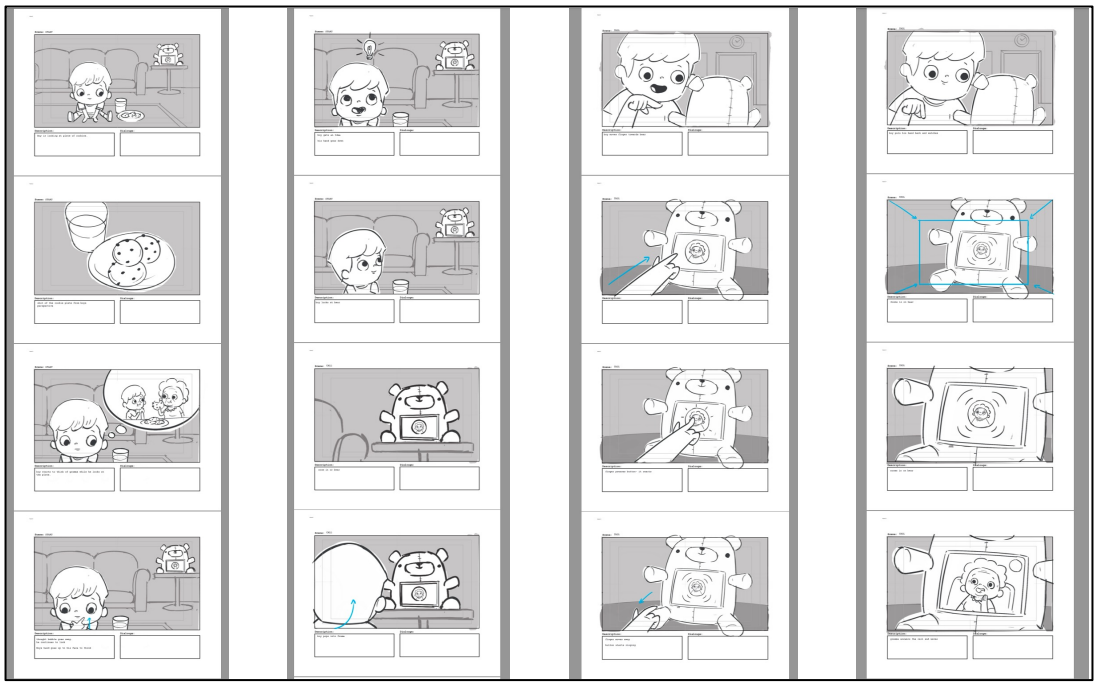

Figure 2. Example iterations of storyboards for our video prototypes.

through such medium than simply with audio [1]. Lastly, we believed it necessary for the prototyped systems to not be bothersome nor create additional challenges for the children's parents (nor the children or grandparents). This requirement was established due to the unlikelihood of parents allowing their children to use bothersome devices (e.g., ones that make a lot of noise or are disruptive to the family dynamic), and therefore removing that concern from parents' feedback. The prototypes also aligned with design requirements for grandparents (as reported in Table 1). The aforementioned components were present in at least one of the three prototype ideas that we created are presented in Figure 1. The video prototypes are available at https://tinyurl.com/clabDIS2026, and the synopses of the videos are presented in Table 2. As a note, the names of the prototypes in the videos do not match those in the paper, as we did not want the prototypes to seem "official" or like finished products/concepts to the participants. We encourage readers to watch the videos in order to understand the extent to which each of the design's interactions were specified. Here we were deliberately vague in relation to specific interface designs, as we wanted the designs to be somewhat open ended and invite participant curiosity and thoughts. That is, the videos highlighted the *interaction* with and through the prototypes, rather than *how* to use the prototypes. Thus, we present high level descriptions of the designs and how they work, rather than low-level interaction details (e.g., click here to do X).

3.1 TeddyGran

TeddyGran (Figure 1) is inherently a teddy bear with an embedded tablet, which allows young children to have synchronous video calls with their grandparents while also providing a portable and cuddly exterior that could potentially foster closeness. Preschool-aged children are usually familiar with stuffed animal toys, and TeddyGran therefore provides a familiar embodiment that can act as a physical proxy for the grandparents. In addition, TeddyGran (as a device) is intended to be easy to carry and likely intuitive to play and socialize with, allowing young children to spend time with their grandparents and share activities and experiences inside and outside the home. Thus, children could hug or hold TeddyGran while also using it as a communication device. With this prototype, grandparents would use a traditional device (i.e., computer, tablet) to communicate with their young grandchildren. We did not specify the interaction with the system beyond the above description (e.g., what does the child push to start or answer a call?) because we wanted to leave it open-ended at such an early design stage. As can be seen, this design concept is similar in nature to past research designs like Family Story Play [26] where synchronous video chat is embedded within an object familiar to a child (a book for Family Story Play). The design differs in that communication is not intended to focus on story reading as there is no book present. In addition, our focus was on reducing the need for parent scaffolding; the need for parental support was found to be strong with Family Story Play [31]. Other designs like FamilyWindow [20] and Family Portals [19] are similar, though TeddyGran's video is not always-on. The design objectives for TeddyGran were: synchronous interaction, sharing of activities and experiences, and spending time together.

3.2 OurStory

OurStory (Figure 1) is a portable prototype idea designed to enable grandparents to asynchronously share stories with their young grandchildren, while the children are entertained and engaged in such stories by drawing. This prototype is composed of two touch screens, one through which one user is able to view content provided by the other user (i.e., drawings or text, and video), and a second screen used to create content. Children can draw the story that their grandparent describes, while grandparents are able to write out the story as they tell it (research suggests that relatives' handwriting is meaningful [43]). Previous research has found that grandparents and grandchildren find the sharing of stories and family history important, as they learn about each other [13, 15]. While children's drawing abilities at this

Table 2. Synopses of video prototypes showed to grandchildren and their parents in our study.

Video Prototype	Synopsis
TeddyGran	Grandchild is having cookies with milk, which reminds him of when he shared the same snack with his grandmother. Then he remembers that he can talk to his grandmother through the TeddyGran. He initiates the connection and a montage follows of the grandchild and grandmother engaging in remote actives together (e.g., eating cookies, drawing, going for a walk, playing soccer, and reading a book) through the use of TeddyGran.
OurStory	The grandchild finds the OurStory device, opens it, and sees that there is a video message from his grandmother, telling him a story. The child then draws the story his grandmother is telling. Later that day, the grandchild receives another story message from his grandmother and proceeds to draw it out on the device. The next day, the grandchild finds a box, which contains the storybook that he and his grandmother created together with OurStory.
GranPortal	The grandchild is drawing a picture in his bedroom and the grandmother is knitting in her home. The grandchild walks up to his GranPortal and his image appears on the grandmother's GranPortal. The grandmother then walks up to her GranPortal and her image appears on the grandchild's device. They wave at each other and the grandchild shows his grandmother the picture he drew. Then he goes to get his teddy bear and shows it to his grandmother. Later, the grandchild walks up to his GranPortal and waits for his grandmother but she does not appear (unbeknownst to the grandchild, she is sleeping). The grandchild is disappointed, but remembers that he can send her a picture using the device and proceeds to do that. When the grandmother wakes up, she sees on her GranPortal that her grandchild sent her a picture of himself.

age are unlikely to lead to legible or interpretable drawings, the goal was to create a sense of bonding and sentimentality through a joint memento [28]. Further, preschool-aged children are commonly unable to read or write, and therefore contribute to the storybook with their drawings, while they watch and listen to their grandparents sharing stories. With this prototype, a grandchild-grandparent dyad creates a virtual storybook together, which we envision would later become a physical book that serves as a keepsake, which provides tangible sentimentality. Again, we did not specify interaction beyond the above so that it was more open-ended for our study participants to consider. This design is similar to Family Story Play [31], though the emphasis is on story generation and creation by young children and their grandparents as we wanted to explore if and how this type of creative interaction would be received by children and their parents, as well as grandparents. Moreover, parent scaffolding was intended to be minimal or non-existent. The design objectives for OurStory were: asynchronous interaction, learning about each other, doing an engaging activity, sharing stories, and having a a ental memento.

3.3 GranPortal

Our GranPortal prototype idea is an ambient video portal that exclusively enables a connection between a young child and their grandparents, which can be used synchronously and asynchronously and is situated but portable (Figure 1). When no one is near the device, a clouded video feed (no audio) of the other user(s) is visible, to ensure privacy as well as sharing a sense of movement and presence in the other household. However, as the child moves closer to their device, the grandparents are able to see the grandchild more clearly, and vice versa. Through this device, preschool-aged children can partake in show-and-tell activities with their grandparents, which commonly take place during traditional video calls and children commonly enjoy [3, 13, 15]. This device provides an ambient reminder of the state and activities of the non-collocated family members. Users are also able to take and (automatically) send a photo or video of themselves

when the other user is unavailable. Most similar to this design in prior literature are the FamilyWindow [20] and Family Portals [19], always-on video portals connecting homes over distance. We incorporated additional features specific to this child age group, including the requirement to be close to the device to engage the video feed and the recording of video clips for asynchronous review. The design objectives for GranPortal were: synchronous and asynchronous interaction, knowing what the other person is doing, and providing visible reminders of others.

4 STUDY DESIGN

The goal of this research was to obtain preschool-aged children's, parents', and grandparents' needs and preferences for devices to communicate with remote grandparents. To that end, we conducted semi-structured interview sessions in which children aged 3-5 years old and their parents provided feedback on the three prototype communication technologies for young children. We separately conducted similar interviews with grandparents who had grandchildren in the same age range. Our methodology is based on established methods for conducting qualitative research with young children [18, 29], including providing visual stimuli to facilitate discussion, making reference to activities and objects known to children, and keeping the interview short. In this section we describe our study design, including each of these components.

4.1 Participants

Eighteen child-parent dyads took part in this virtual interview study (19 completed the study but one was removed due to connectivity issues that led to unusable data). Dyads were composed of children aged 3-5 years old (M=3.5, SD=.71, 13 males, 5 females) and a parent (15 females, 4 males; 1 session had both parents participate). Eight grandparents (aged 55-85, M=69.50, SD=8.93, 2 males, 6 females) participated separately. Participants were recruited through word-of-mouth, snowball sampling, and online forums in mid-sized cities in North America. To be eligible, children had to be between 3 and 5 years old and have living grandparents that they interacted with. Grandparents had to have grandchildren between 3 and 5 years old that they interacted with. Children, parents, and grandparents also had to speak English. Fourteen of the children spoke or spent time with their grandparents at least once a week, if not more frequently, through video communication software (9 children), in person (3 children), or a combination of both (2 children). Some grandchildren lived in the same city as their grandparents while others lived in different provinces or countries (all children lived in North America); however, we did not ask the location of the grandparents explicitly. This research was approved by our University's Research Ethics Board, and dyads were compensated with $50 while grandparents with $30 in our local currency. Parents completed a consent form for themselves and their child, grandparents just for themselves, and verbal assent was obtained from the children before each study session.

4.2 Procedure

In phase one, child study sessions took place virtually on Zoom, and each session was comprised of a child and at least one of their parents. The child and parent dyads were shown the three video prototypes (one at a time), depicting different modalities in which a child could interact and spend time with their non-co-located grandparents. This methodology is inspired by speculative enactments [8], where participants provide feedback on speculative but meaningful scenarios. Speculative enactments typically involve participants exploring and reflecting on alternative sociotechnical configurations within society. Given that we were working with preschool-aged children, we chose to simplify the approach and present design ideas within somewhat familiar scenarios that were extended in plausible ways. Since preschool-aged children might have difficulties simply imagining such scenarios, we provided videos in

which a child interacts with his grandmother with our prototype ideas in an effort to have children imagine themselves in that same situation. In addition, after each video prototype was shown, the experimenter explained to the child what had happened in the video, and provided the child with a frozen frame of the video depicting the child and the grandmother using the prototype. Further, previous research suggests that speculative thinking might actually be best suited to young children, due to their ability to engage in imaginative and pretend play [6]. The videos we presented to our participants were animated in nature and showed how a child and his grandmother might use each system in a day. The three prototypes presented were TeddyGran, OurStory, and GranPortal (see Section 3 for detailed explanations). Parents and children were allowed to talk while the video played, discussing what they saw and their reactions. The order of the video prototypes was counterbalanced between participants (i.e., child-parent dyads).

After viewing each video prototype, children were asked to provide feedback on what they liked and did not like about it, whether they would want to use it with their grandparents, and when they may want to use it. See Table 3 for our interview questions. Parents were asked to not interfere as much as possible and let the child answer as they wished. If a child did not hear or understand a question, their parent would repeat it and then let the child respond. Any child responses that appeared to be due to something a parent said were analyzed with that in mind. If a child was having trouble voicing their opinions, they were given the option to draw their answers (e.g., how they would use the prototype with their grandparents). Nine children chose to draw during the study session, either to illustrate their point or to keep them focused on the task at hand; however, some child participants drew unrelated things (such as bunnies). Parents also helped to translate what their children were saying to the experimenter when necessary.

After viewing all prototypes, parents were asked what they thought about the prototypes, any concerns that they may have about their children using them, their advantages and disadvantages, and how they thought the systems could

Table 3. Interview questions asked during study.

Child Questions	What would you tell your friends and family about this toy? What did you like about this toy? Is there anything you would change? What didn't you like about this toy? Is there anything you would change about this toy? Do you like that you could use this toy alone or would you want your mom's/dad's help? Which toy was your favorite? Why?
Parent Questions	What is your first impression of this idea? What concerns would you have about your child using this system to interact with their grandparents? What might be the advantages of your children and parents using this system? What might be the disadvantages of your child and parents using this system? When would you use or not use this system? Why? How would you improve this system?
Grandparent Questions	What is your first impression of this idea for connecting with your grandchild? Why? Which aspects do you think would help you connect with your grandchild? Why? What challenges do you anticipate when using this system? Why? What might be the benefits of your grandchild and you using this system? Why? What might be the disadvantages of your grandchild and you using this system? Why? When would you expect the tool to be used or not used? Why? How would you improve this system? Why?

be improved. Parents were also given the option to complete a survey instead, in case they needed to care for (i.e., run after) their child (3 parents chose to do this). Child and parent interviews were conducted in a semi-structured fashion. Questions asked were inspired by related work on grandchild-grandparent communication (e.g., [13]) and the authors' experience in Developmental Psychology and conducting research with preschool-aged children (see Table 3). Study sessions lasted approximately 30 minutes in total (with the child components lasting only 15 minutes), which reflects typical attention spans of children in this age range. A study of longer duration would likely have been very challenging for children. The sessions were conducted by the first author, who has 9 years of experience conducting research with preschool children in HCI and Developmental Psychology.

In phase two, grandparent study sessions took place in a similar fashion, where grandparents watched the video prototypes (order counterbalanced between participants) and then answered semi-structured questions about any concerns that they may have with the prototypes, its advantages and disadvantages, and how they thought the system could be improved. Grandparents were asked similar questions as parents and children, but from their perspective. Study sessions lasted approximately 30 minutes for dyads and 45 minutes for grandparents. The grandparents in our study were not the grandparents of the child participants in order to reduce recruitment complexity.

4.3 Data Analysis

We conducted a thematic analysis following established methodologies for HCI [5]. Recordings from the semi-structured interviews were first transcribed. Transcriptions were obtained from verbal and non-verbal responses (e.g., a nod as a response to a question was coded as "yes"). The data from the transcripts was then open coded for our three prototypes, focusing on novel, interesting, and relevant information pertaining our research questions. Following, the codes were reviewed and discussed by the first and last author (who are both highly experienced in qualitative coding of data), narrowing down on important elements. These codes were then grouped into relevant and related themes, and quotes were identified to support our findings. The themes were then reviewed by these authors, and subsequently refined. The final themes found in our analysis were: independence, expectations, privacy and security, short interactions, and practicality. We further discuss our findings, in the context of these themes, in section 5.

5 RESULTS

In general, as it relates to our first research question, when asked which prototype they preferred (after having viewed and answered all questions for all three) children stated that they preferred the GranPortal prototype the most, saying things like *"I like this one"* [P14 – 3-year old male] and pointing to it. The TeddyGran was also liked by children, while the OurStory prototype was liked the least. In total, 4 children preferred GranPortal, 3 children TeddyGran, 1 child OurStory, and 2 children preferred both GranPortal and TeddyGran (the remaining 8 children did not state a preference). Beyond such preferences, which we note could change over time, what stood out for us was that children seemed to like how easy the GranPortal was to use (*"like you press the button and it [grandparent] comes there"* [P9 – 3-year old male]), and how it would allow them to show things to their grandparents (*"I want to show them my sloth"* [P5 – 4-year old female], referring to their stuffed animal toy) and for their grandparents to show things in return (like *"food"* [P15 – 3-year old male]). This is somewhat linked to our design objective of knowing what the other is doing with GranPortal. One participant justified their preference for the GranPortal *"because I need to talk to my grandma, so I need the picture frame [GranPortal]"* [P2 – 3-year old, male]. Almost all children said they would use TeddyGran to communicate with their grandparents, as they could play with the teddy bear (e.g., *"[take the bear] to preschool!"* [P12 – 4-year old male]) and video chat with their grandparents simultaneously (*"I'm gonna talk to my grandma and grandpa"* [P5 – 4-year old

male]). This relates to our design objective of sharing activities and experiences, as well as spending time together. One child also liked that they would be able to use TeddyGran on their own to join "meetings" at night (having heard his parents refer to video calls as meetings; *"I could join meetings at night"* [P1 – 5-year old male]), to say goodnight to his grandma. Overall, children were less enthusiastic about the OurStory prototype, only stating that they simply liked it without additional information such as to why or how/when they would use it (e.g., *"I like that I can draw"* [P11 – 3-year old male]). A few children either strongly disliked the OurStory prototype (2 children; e.g., Experimenter: "*is there anything you like about this toy?"* Child: *"nothing"* [P8 – 3-year old female]), or disliked aspects of it stating that they did not want it and would not use it (1 child),

Experimenter: *"would you want to use this with your grandma and grandpa?"*

Child: "no."

E: *"why not?"*

C: *"because nobody plays with me."* [P3 – 4-year old male].

Through the interviews, it appears that this dislike for OurStory stems from the asynchronous interaction, as the child would be using the device by themselves without actually interacting (or "playing") with their grandparents at the same time.

As for our second research question, parents generally liked the OurStory prototype, although they agreed that their children were too young for it given their rudimentary drawing abilities and unlikelihood that they would draw what the grandparents shared. They liked the ability of the grandparents to share their family history with their children, and that this history is then preserved in a book as a keepsake, e.g., *"I don't think he's age appropriate yet to be able to draw. But I think if he was more like 5, 6, 7 that would be beautiful, to be able to draw those stories. So I think that was super special"* [P18, parent]. This is linked to our design objectives of sharing stories and having a sentimental memento, both present in OurStory. On the other hand, parental opinions on the TeddyGran prototype were split. Some parents loved the idea of the TeddyGran because it is tangible and can easily fit into their child's life (i.e., because it is a teddy bear) – *"I think the teddy bear is good because she can take it with her to places, she can try to feed it. She can kind of incorporate it into her daily routine"* [P19, parent] – while others strongly disliked it, referring to it as creepy *"I thought the bear was maybe kind of creepy in a way"* [P10, parent] and stating that they do not want a teddy bear to replace the grandparents – *"my children do not need a robot to cuddle in place of actual interaction"* [P2, parent]. The GranPortal prototype therefore seemed to be a good middle ground for parents – *"the picture frame [GranPortal] I could see him at this stage, if it was actually here, I could see him actually being like excited to go and show something, or something like that."* [P6, parent].

Grandparents, the focus of our third research question, had mixed preferences with 3 choosing TeddyGran, 3 GranPortal, and 2 choosing OurStory. Grandparents liked the portability of TeddyGran (e.g., "*kids love to move around with their teddy and… it makes it easier for the grandparents"* [P20, grandparent]) and its physical design (e.g., *"TeddyGran is bigger, you know, more cuddly, and it's cute and different from all the other things in their room"* [P25, grandparent]). They also liked the portability of OurStory, and thought that it would be suitable for older young children (e.g., 4-5 years old) because of the *"more levels of interaction possible with the drawings"* [P26, grandparents]. As for GranPortal, grandparents like the versatility in being able to communicate synchronously and asynchronously, e.g., *"If somebody's not available,… I just leave them a message. They could get it when they get back and call me back at their convenience and vice versa."* [P20, grandparent] and its general simplicity *"I like it very much, because it looks to be so easy for both"* [P25, grandparent].

Below, we detail the major themes that we found with children, parents, and grandparents through their feedback on the video prototypes.

5.1 Children's Desire for (some) Independence

When asked whether they would want to use the prototypes on their own or with their parents' help, children were generally excited about the prospect of being able to contact their grandparents on their own, indicating that they would want to use the prototypes on their own, without parental assistance (e.g., *"[I want to] use it by myself"* [P10 – 5-year old male]). This suggests that while current solutions (e.g., smartphones, laptops, Skype, Zoom) do not facilitate preschool-aged children to communicate with their grandparents independently, children do yearn for this ability [12]. However, children within this age group do not seem ready to become fully independent, and many stated that they would like their parents' continued help to connect with their grandparents, even if devices make full independence possible *("I want mom's help"* [P6 – 3-year old male]). There seemed to be a tension between the desire for independence and the simultaneous uneasiness over becoming independent in children (*"I want my mom's help… [and to] use it by myself"* [P9 – 3-year old male]).

While children may not be ready to completely let go of their parents' help, parents were excited about the idea of their young children depending less on them to communicate with the grandparents *"I don't have to be there all the time. So it kind of offsets a little bit of the responsibility to stay connected"* [P14, parent], gaining more independence, e.g., *"wouldn't it be beautiful if you could see him initiate a conversation with your mom?"* [P12, parent 2 to parent 1], and having their own portal to their grandparents:

> *"he's bonding through this teddy bear I think it's a much better idea because it's his, it's not ours. Whereas he sees the devices like the phone and the iPad sometimes that can trigger him because it's not me giving him attention, it's more my mom talking to me and he can come in and out of the conversation"* [P16, parent].

Grandparents were similarly excited about their young grandchildren taking communication into their own hands *"they can have their own bit of independence, and be able to do something without needing the parent standing there"* [P23, grandparent], without the need for parental scaffolding, e.g., *"My son has to operate the facetime for him, so he's been doing that since he was a baby, and sometimes he gets frustrated when he [grandchild] says 'I want to call [grandparent]', but you know my son is busy, or he's cooking or something"* [P25, grandparent].

However, parents also wanted to maintain some level of control over their child's use of devices. Specifically, parents wanted to be able to set boundaries as to when the communications took place to preserve certain rituals, e.g., *"it would be trickier to set boundaries about things like 'now it's time to go to bed' and stop bugging your grandparents"* [P4, parent], and for security reasons (further discussed in section 6.3). Grandparents also believed that their children (the grandchildren's parents) would prefer to plan calls beforehand, whenever it suited their schedule, e.g., *"I usually leave it up to my daughter to initiate the connection. It's much easier. It's less disruptive that way."* [P23, grandparent]. Parents were also concerned about the amount of screen time *"I don't really love him to have too too much screen time, because in our situation I find that too much screen time, when it's taken away, it's really difficult for him."* [P10, parent], but some thought screen time was justified if it was in pursuit of connection *"if we're going to use screen time for it to be something for connection"* [P18, parent].

5.2 Children's, Parents', and Grandparents' Expectations

One concern children (and some parents) had was the possible failure to connect with their grandparents, for example, if they called with the TeddyGran or went up to the GranPortal and their grandparents were not on the other side to answer return their call attempt *"I didn't like when they [grandma] show up when the screen is not even on"* [P1, 5 years, male referring to a scene in the GranPortal video prototype]. On the other hand, parents and grandparents were concerned that if children had the ability to contact their grandparents at their will, that they might overuse this power,

causing the grandparents to be annoyed at the constant requests for interaction "*I can see it working better with some [grandparents] than others, the ones who are more amenable to an instant connection"* [P4, parent], *"Well, if <grandchild>, for example, wanted to play with dinosaurs - I'm gonna to play with grandfather... And he was to sit down and call me. What if I'm not available now? He's disappointed."* [P24, grandparent]. Similarly, parents were also concerned about grandparents wanting to connect at inappropriate or inconvenient times:

> *"sometimes when grandparents want to talk when it's not a good time or him wanting to talk when it's not a good time. I love him connecting but also, you know, sometimes we have to get going and get out of the house"* [P18, parent].

This finding suggests that systems should take into account what the expectations of the children and parents might be (along with those of grandparents), and design interaction that either meets or manages those expectations. In addition, always-on systems may bring on the expectation and therefore pressure to always be available for grandparents as well as young grandchildren.

5.3 Privacy and Security Concerns

Parents and grandparents were generally concerned about privacy and security issues related to the prototypes in our study, including: the possibility of the devices being hacked, who could have access to their children through these systems, and sharing aspects of the family's lives that they would not want to share. For example, they had concerns about the TeddyGran and GranPortal prototypes transmitting video without their knowledge, e.g., *"being close to the frame [GranPortal] and sharing data by accident"* [P3, parent], *"when is it actually like on? ... When is grandma in the room?"* [P6, parent], *"We don't want them to be able to just barge in on me. Maybe I'm getting undressed. I don't want my grandchildren to barge in while I'm in the middle of doing something, you know."* [P24, grandparent]. Similarly, parents and grandparents also wanted to ensure that these systems can only be used between the grandchild and grandparents (or other close relationships in some cases):

> *"how is it protected so that no one else can get into it, that I know who's on the other end of it, so that security piece" [P18, parent]*
>
> *"I mean I guess the big thing is security. You know like who else is being able to access their chats when they are talking? How secure is it? ... will there be interference?"* [P1, parent]
>
> *"I worry about hacking"* [G25, grandparent].

Surprisingly, some young children in our study also seemed to allude to some privacy concerns. For example, one child mentioned that they would want TeddyGran to have a blindfold on its eyes, presumably so that the bear (or anybody else) cannot see them (e.g., experimenter: *"what didn't you like [about TeddyGran]?"*, child: *"no blindfold ...on its eyes"* [P3, 4 years, male]). Another child (4 years, female) also mentioned that they did not like the teddy's eyes, possibly disliking it could 'watch' her. Children therefore seemed somewhat conscious about their privacy being possibly invaded. One child also chose GranPortal as their favorite prototype because *"I wasn't seeing anybody"* [P3, 4 years, male] when the grandparent was not close to it, possibly suggesting that they would also be giving their grandparents some privacy.

5.4 A New Type of Interaction

More so than a particular prototype or feature, parents and young children liked the idea brought forth by our systems, of spontaneous, child-led, bursts of connectivity between a young child and their grandparents. Similar to previous research [1], parents mentioned that children often misbehave during phone or videocalls with their grandparents

because they tend to be lengthy and the adults often choose when they take place. Participants therefore liked that with all of the prototypes the child could initiate the communication and was therefore more likely to enjoy it, e.g.,

> *"it would just be nice for him. It doesn't always have to be initiated by a formal call, like where everyone's available. But there can be more random occurrences and meetings, which I think is an interesting thing to have at a distance… so I think that that's something that's really missing in these calls… So I think having these small little instances would probably be better."* [P6, parent].

The ability to informally start and end communication sessions with the grandparents also meant that the sessions were likely to be shorter and more frequent, which parents thought would lead to a deeper connection between the young grandchildren and their grandparents, e.g.,

> *"instead of having this one consecrated time, you have these little moments throughout the day that they can stay connected… so if it was sort of like these shorter snippets. That's what's hard about having family that lives far away, is that then when you see them, you see them for a really long time, and you lose these day-to-day sort of check ins… I think an advantage too is that it's just them communicating…, but then with this particular thing it would just be them, and they develop more of a relationship that way"* [P12, parent 2].

Grandparents also highlighted that their young grandchildren tend to have short attention spans, given their age and abilities, which might suit burst-style interactions like the ones in our prototypes, e.g., *"children's attention span's short"* [P27, grandparent].

5.5 Practicality of Systems

In terms of the prototypes presented, parents and grandparents were especially concerned about practical aspects such as the durability and washability of the devices, given the young age of the children. Multiple participants mentioned concerns about how durable the systems would be, stating that children would likely break them quickly. This was seen as a serious issue if the child had built a bond with their grandparent(s) using a device which then broke, e.g.,

> *"they've built that connection, he loves that toy, and then it breaks. What am I going to do then? So now not only is it a toy, it's a toy that's connected to a person. So if it breaks I'm worried that it might create a disconnect. But perhaps it'll make him feel like oh (grandma) is not responding, why is that? She doesn't want to talk to me anymore? How do I explain that to him, that it's not (grandma) that it's just the toy that's broken"* [P14, parent].

Parents also mentioned aspects such as the washability of the devices, especially TeddyGran, and the cost of the device as relevant factors of whether they would let their children use such devices or not, e.g., *"I was wondering about washing the bear, if you could take the screen out"* [P12, parent 2], *"him breaking them…all dependent on the cost too"* [P14, parent].

6 DESIGN VALUES FOR COMMUNICATION TECHNOLOGIES FOR YOUNG CHILDREN

Through our research, we were able to obtain insights into how preschool-aged children might prefer to communicate with their extended families, such as grandparents, when not co-located, as well as parents' and grandparents' preferences and concerns. In this section, we synthesize our findings to provide a set of design values (design aspects that we must consider and incorporate) for use when designing technologies that enable young children to communicate with their families. These design values are from the perspective of the children, their parents, and grandparents, and further research is necessary to assess whether they also apply to other family members of young grandchildren.

6.1 Young Children Need Some, But Not Full, Independence

Our findings suggest that preschool-aged children may want to communicate with their grandparents semi-independently, and possibly other extended family members, with some help from their parents. Previous research has found that current communication systems force young children to be fully dependent on their parents' desire and time to facilitate communication [3, 42], and suggested developing systems to support increased independence [43]. Thus far, commercial systems have not made this possible, requiring multiple buttons and options to be pressed to be able to establish a connection. Similarly, research systems like Family Story Play [31] and Story Visit [32] relied heavily on parent support during calls, which was natural given the type of reading activity they were focused on. However, simple systems could be designed that exclusively allow young children to communicate with their extended family. This could be done through the introduction of an always-on device into both homes that only allows a connection between the young child and family members or through devices that allow various connections but are limited to those added by the parents. The caveat is that parents want their young children to be able to connect on their own while still retaining some control over when that takes place and with whom, and grandparents likewise believe in some restricted access. Systems could therefore have additional controls that only the parents can access, such as on/off switches, logs of who the child has been speaking to and for how long, as well as clear indicators of when a device is transmitting video or sound. While previous research has discussed the role of parental scaffolding in grandchild-grandparent communication [1, 3, 9, 13, 26, 42], to our knowledge, our study is the first to explore ways of supporting preschool-aged children's independent communication with their grandparents, as well as finding children's, parents', and grandparents' conflicting tensions between the desire for independence and for parental involvement. Prior work has also shown that some grandparents value connections that reduce parent scaffolding because they feel like they are more directly in contact with their grandchildren [12]. The aforementioned design features could therefore help grandparents and presumably other extended family members to have more valued connections and interactions.

6.2 Spontaneous, Child-Lead, Bursts of Interaction

In our study, parents found the idea of more frequent and informal interaction sessions between their child and, for example, grandparents to be valuable, and believed that this would increase emotional connectedness between them. Prior work shows a similar desire by grandparents [12, 13]. In addition, parents in our study suggested that child-led and shorter interactions would likely lead to better behaved children during these interactions. Grandparents seemed to agree with this, stating that short interactions are the norm with their young grandchildren. This design value emphasizes child-led interaction, reflecting a form of emerging agency in early childhood rather than full autonomy. While children in the study were not fully independent, they expressed a desire to initiate and shape interactions with their grandparents. Systems should therefore attempt to support these short bursts of connectivity between young children and their extended families, by providing ways of interacting that are less formal (and possibly shorter in duration) than a video or phone call, or by supporting more passive interaction. This is in contrast to findings from systems like Family Story Play [42] and Story Visit [32] that attempt to increase the duration of calls between young children and family members. It also maps to the needs reported by some extended family members, such as grandparents in grandparent-grandchild communication [12]. Ambient displays, like GranPortal which was preferred by children in our study, might be a good way to provide this type of novel interaction. More traditional communication systems may also give preschool-aged children the option of when they would like to communicate with their family within a larger window of time, providing them with more control over how they spend their time and therefore decreasing the likelihood of disruptive behaviors. Previous research suggests that children often get bored and restless after even short

phone and video calls [9, 13, 31]. However, our research suggests that short bursts of child-led interaction could be attempted as a novel solution to increase the amount of communication between young children and grandparents. Nevertheless, bursts of interaction could also lead to too much contact, causing communication fatigue or proving annoying for family members. This was a parent and grandparent concern in our study. Providing parents and grandparents with some control over when these spontaneous interactions take place could remedy this concern.

6.3 Managing Availability Expectations

Through our study, we found that children seemed concerned about their grandparents being unavailable, and therefore not reciprocating their attempt to communicate (whether an actual call through TeddyGran or moving closer to GranPortal to come into view). This is extremely relevant, as children may have a different idea from their extended family of the amount and frequency of contact that is appropriate or desired. Thus, systems need to take these expectations into account, to decrease the likelihood of children's disappointment and family's annoyance. This could be done through making the system clearly available and unavailable at various times of the day or on demand. Devices could alternatively employ a type of "answering system," where if the remote family member is unavailable, a pre-recorded video message of them appears for the child to view. As far as we are aware, no systems intended for young children and extended family members have considered managing availability expectations, especially on the child's side. Vutborg et al. [42] mention that as part of using their storytelling system, parents (usually the mother) would start sessions themselves and only call the child if the grandparents were available, therefore scaffolding the interaction. Somewhat similarly, parents in The FamilyWindow [20] would use the device to observe whether the other individuals were available prior to phoning them. However, this was not related to the children nor did they use this information to make use of the device. Family Story Play [31] and Story Visit [32] did not focus on an awareness of availability. Thus, to our knowledge, managing children's expectations for communication is a novel insight that stems from our research.

6.4 Simplifying Interactions vs. Managing Privacy Concerns

Concerns over who can access the video feed on devices and whether children can be contacted by individuals other than their family members arose in our study, not only by parents and grandparents but also seemingly by some of the children. In addition, when and how a device is activated was also a point of concern with parents, grandparents, and children. Therefore, in addition to systems for young children providing a secure connection to specific extended family, and only them, devices should also provide some form of indication that the device is activated and transmitting, as well as who it is transmitting to. In our prototypes, we focused on providing simple interaction paradigms that preschool-aged children could carry out on their own. However, these ease-of-use features (such as the proximity interaction with GranPortal) can also increase privacy risks, causing devices to be activated without users' knowledge. This tension between creating simple interactions that young children can use independently and the potential privacy risks that arise due to that simplicity need to be further investigated and new design solutions proposed. Thus, systems that aim to facilitate communication between young children and their extended families need to maintain a delicate balance between enabling usability by children (to support child-led usage) and maintaining their privacy (as well as their family's). This could be done through equipping such devices with appropriate feedback (e.g., lights) to indicate when a camera or microphone is transmitting, or providing parents with notifications of when the devices are activated, for how long, and with whom. This might make parents, grandparents, and children more comfortable. Likewise, devices could increase connectedness without the need of transmitting audio or video, such as by automatically sharing photos that were intentionally taken. This also maps to the needs of some extended family members, especially grandparents, that

highlight the value grandparents find in simple interactions and information sharing [12]. Researchers have previously found that privacy and security are of concern with devices in the home (e.g., [27, 36]) and have discussed balancing aspects such as awareness [38] and providing solutions such as logging into a system when they would like to be available (e.g., [21]) or physical objects such as opened versus closed cabinet doors [45]. Nonetheless, the tensions between creating simple device interactions for young children and, as a result, managing privacy concerns has not been discussed until now.

6.5 Designing for Practicality and Proxy

The practicality of communication systems for young children was a large concern for the parents and grandparents in our study, as they were accustomed to children breaking or dirtying toys and child-focused technologies. Thus, systems for young children should be constructed from durable materials, that will be able to withstand being dropped, thrown, and soaked. This is especially important for devices that allow children to communicate with others exclusively, and that are likely to become proxies for those individuals. A device that is linked to a family member, such as a grandparent, and then breaks could cause a child to misunderstand the situation and believe that the individual no longer wants to speak to them or that it is the family member who is "broken." Devices for children should also be washable, with the ability of removing electrical components in some cases, to be able to clean them thoroughly. Otherwise, parents are unlikely to make these devices available to children for independent use, removing the benefits of systems like the ones we prototyped for our study. However, children may also interpret their device being taken away to be cleaned in unexpected ways, and may get upset about having to part from the device or have a 'fresh' start. This might even cause a pause in the relationship between the child and family members, if the child's parents do not provide a secondary method of communication. Thus, while providing devices that can serve as physical proxies for extended family might be beneficial for family connectedness, such proxy could also cause some harm and confusion for children, and should be carefully considered and studied. These perspectives of communication devices as proxies for extended family members, and what children's perceptions and responses might be, is novel and has yet to be explored in HCI.

7 LIMITATIONS

This research has a number of limitations. Our study sessions were conducted virtually, which meant that children were prone to getting distracted or bored and sometimes had to be refocused by the experimenter or the parent. This limited our study sessions to typically a maximum of thirty minutes (15 of those focused on the child). The online nature of the sessions also meant that parental scaffolding was necessary during the child sessions, and parents often needed to repeat questions that the researcher asked the children or interpret what the children said and relay it back to the researcher. While parents repeated the questions as closely as possible to how the experimenter stated them, there is a chance that this scaffolding affected children's responses during the study. Although this is one of the recommendations for research with young children (e.g., [29]), we analyzed and interpreted children's responses with this in mind.

Further, while the use of video prototypes was necessary to initially investigate this area and ground future work (and because of the online nature of the study), there is a chance that these videos may have biased participants in ways that we are not aware of, such as by limiting the creativity of the proposed prototypes. We countered this limitation by creating video prototypes that were somewhat open ended in terms of how users interacted with them while still focused on specific design features. In addition, participants were only able to watch the videos (and only once), as opposed to interacting with the proposed devices. Therefore, future studies should further investigate our findings with physical prototypes that allow participants to use the proposed systems in ecologically valid situations, and for extended periods

of time if possible. Our research is a necessary precursor step towards this work that can help researchers understand what designs are worth creating as physical prototypes for further testing.

Lastly, while we included grandparents in our research, to obtain a holistic perspective on young grandchild-grandparent communication, the grandparents that we recruited were not from the same families as the children and parents. This was due to difficulties in scheduling all parties at the same time, and the sequential way in which we conducted our study (all child-parent sessions were conducted before the grandparent sessions). Similarly, we were only able to obtain 8 grandparent participants, and while it appears that we reached data saturation, a larger sample may have provided more insights. In the future, it would be beneficial to conduct sessions with the whole family unit to obtain a more cohesive picture of communication within different family dynamics.

8 CONCLUSION

Interaction between young children and extended family, such as grandparents, is valuable to both, and when they are not co-located, remote interaction needs to be supported. We conducted a study with preschool-aged children and their parents, as well as grandparents of young grandchildren based on established methodologies for qualitative research with young children, where they provided feedback on three video prototypes that would allow the children to communicate with their remote grandparents. We found themes such as tensions between independence and parental involvement, expectations, privacy and security, spontaneous bursts of interaction, and practicality. We further provided various design values based on our findings that can be applied by researchers and designers to create systems and devices that young children are able to use to communicate with their extended family. Our work provides a novel perspective on how to design communication technologies for young children to communicate with remote extended family members (i.e., grandparents), specifically focusing on the needs of the child and the child's parents.

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9 SELECTION AND PARTICIPATION OF CHILDREN

This study was reviewed and approved by the Institutional Research Ethics Board at Simon Fraser University in Surrey, Canada. Children were recruited through their parents, who were recruited through word-of-mouth and posts on online discussion forums. Parents completed an informed consent form prior to the study session and a researcher explained the study procedure to the child at the beginning of the session, asking for verbal confirmation that they understood what would take place and that they could end the study at any time. All study sessions took place with a child participant and at least one of their parents. Study sessions were video recorded and parents indicated whether the videos could be disseminated and how in the consent form.

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